Breakability: CE-399 and the Diminishing Velocity Theory

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The Single-Bullet Theory

The Warren Commission's conclusion that Lee Oswald alone assassinated President John F. Kennedy hinged not upon physical evidence, but upon the integrity of a single theory; the single-bullet theory (SBT). And a brittle theory it is, for if any component, no matter how seemingly insignificant fails, the case for a single assassin evaporates.

This is so for two reasons. Firstly, by happenstance Dallas resident Abraham Zapruder captured on motion picture film the wounding of Kennedy and Governor Connally, who was seated in front of the President. Secondly, the alleged assassination rifle, designated by the Warren Commission as Commission Exhibit 139 (CE-139) cannot be recycled and fired fast enough to get off two shots in the time between the observable reactions of Kennedy and Connally in the film. It follows that if Kennedy and Connally were hit with separate bullets, they could not both have been fired from CE-139. It would inescapably follow then, that two weapons were fired at Kennedy. Thus one bullet *must* have hit both men or the assassination cannot be the work of a sole assassin.

At the very heart of the SBT is the single bullet itself, designated CE-399 by the Warren Commission and often referred to as the "Magic Bullet." Given that CE-399 *must* have caused all of the non-fatal wounds suffered by Kennedy and Connally, its ability to perform that task and remain in the condition in which we find it is paramount to the conclusion that a single assassin took President Kennedy's life.

After a flimsy investigation, the Warren Commission told us only that the SBT was possible, not that it actually happened. Then, in their Report, the Warren Commissioners disingenuously downplayed the fact the Kennedy and Connally *must* have been hit by the same bullet or conspiracy is proven:

> 3. Although it is not necessary to any essential findings of the Commission to determine just which shot hit Governor Connally, there is very persuasive evidence from the experts to indicate that the same bullet which pierced the President's throat also caused Governor Connally's wounds. [WCR19]

This sentence could not be farther from the truth and the Warren Commission members knew it. They could not scientifically prove the validity of the SBT so they pretended it didn't matter. The next investigation would at least make a pretence of settling the issue.

The House Select Committee on Assassinations

Nearly twelve years after the Warren Commission issued its *Report*, the House Select Committee on Assassinations (HSCA) began a re-investigation of the Kennedy assassination. One of the issues facing that Congressional investigation was the plausibility of CE-399's remarkable supposed journey. Through the course of its work the HSCA applied various scientific methodologies to address the SBT issues. It concluded in 1979 that CE-399 indeed went through Kennedy and Connally,[1] and that the bullet was fired from the "Oswald" window of the TSBD based primarily upon a combination of Neutron Activation Analysis (NAA),[2] acoustics, photographic analysis, and a trajectory analysis.

In the end, the HSCA artfully (if not actually) validated the SBT. However, the scientific foundations upon which the HSCA based its conclusion that the SBT was legitimate and that CE 399 was the single bullet crumbles under careful scrutiny.

Another example of how the HSCA purported to validate the SBT, and one which speaks to the heart of this essay concerns their attempt to show that the marginally deformed bullet *could have* inflicted all of Governor Connally's wounds and *still* remain in the mildly distorted condition in which it exists. That lack of deformity had been (and continues to be) a source of legitimate concern. Rightly so, critics have asked, "how could the bullet smash a rib and wrist bone and yet sustain only the mildest of distortion?"

In an attempt to blunt the argument that CE-399's physical condition precluded its having caused Governor Connally's wounds, the members of the HSCA's Forensic Pathology Panel (FPP) endeavored to produce a documented instance of a jacketed bullet having inflicted the amount of damage attributed to CE-399 and emerged in a comparably unscathed condition. Wrote the FPP:

> Several members of the panel have investigated deaths in which missile impact resulted in deformation similar to the flattening noted in Warren Commission exhibit CE 399, and instances in which there was loss of the central core mass of a jacketed bullet as a result of deformation of the intact jacket and squeezing of the lead core backwards (a toothpaste effect) [7HSCA172]

The claim by the FPP members to have "investigated deaths in which [the] missile impact resulted in deformation similar to the flattening noted in Warren Commission exhibit CE 399" is suspect for several reasons. On first blush, the *insinuation* is that the members have seen bullets do what CE-399 is supposed to have done. But that is not the case. In fact, all they really told us was that they'd seen bullets with comparable damage. This information is absolutely useless without telling us *how much damage* these alleged SBT-like bullets were supposed to have inflicted. Absent that information, the FPP paragraph is worthless at best, and intentionally misleading at worst.

In any event, the HSCA was never able hold up a real bullet and declare, "Here is a bullet that physically did what CE-399 is purported to have done. See, it is possible." That evidentiary shortfall left the HSCA with the problem of having to account for *how* the bullet could have remained so remarkably intact after causing the following ten points of damage:

- The holes in John Kennedy's back and throat, and the tear to the tracheal cartilage in between.
- The holes in John Connally's back and chest, pulverizing a large portion of his fifth rib in between.
- The holes on the top and bottom of John Connally's right wrist, fracturing the radius bone in between.
- The superficial hole in John Connally's left thigh.

For the SBT to survive as a credible explanation of the Kennedy/Connally non-fatal wounds, that single bullet *must* have been able to inflict the above damage and emerge in its minimally deformed condition. If CE-399 cannot cross this threshold, the inescapable conclusion follows that John Kennedy was assassinated as the result of a conspiracy.

The HSCA *Report* explained the basis upon which it concluded that CE-399 *could* have caused the Kennedy/Connally damage and not suffered more damage:

> Further, the committee's wound ballistics expert [Larry Sturdivan] concluded that the bullet found on the stretcher--Warren Commission exhibit 399 (CE 399)--is of a type that could have caused the wounds to President Kennedy and Governor Connally without showing any more deformity than it does.(37)
>
> In determining whether the deformity of CE 399 was consistent with its having passed through both the President and Governor, the committee considered the fact that it is a relatively long, stable, fully jacketed bullet, typical of ammunition often used by the military. Such ammunition tends to pass through body tissue more easily than soft nose hunting bullets. (38) Committee consultants with knowledge in forensic pathology [the Forensic Pathology Panel] and wound ballistics [Larry Sturdivan] concluded that it would not have been unusual for such a fully jacketed bullet to have passed through the President and the Governor and to have been only minimally deformed. (39) [HSCAR45]

Each of the citations in the above passage concerning CE-399's ability perform as required reference the HSCA testimony of Wound Ballistics Researcher, Larry Sturdivan, which testimony will be discussed shortly.[3]

The Bullet in Question

CE-399 is a long, stable military round designed to remain intact as it passed through a target. Its construction consists of a lead core encased in a hardened copper shell (except at the base where the lead is exposed). This design honors the requirements set forth in the Geneva Convention, which sought to wage war in a more 'humane' fashion by injuring, not killing the enemy. The reasoning for jacketed bullets was the notion that a hardened bullet (such as CE-399) will pass through the victim, yet remain intact (assuming several factors that do not bear on the issues raised here) thus causing enough damage to take the soldier out of the fight, but not enough kill him or cause undue suffering. By contrast, the ammunition used by today's law enforcement officers is designed for the opposite purpose; those unhardened bullets are specifically designed to deform quickly and thus expend all of their kinetic energy in the target, thus minimizing the risk of the bullet reemerging and striking innocent bystanders.

With this understanding of CE 399's design and construction, and given that the average muzzle velocity when fired through the Mannlicher Carcano carbine was on average 2,165 feet per second (f/s),[4] it's not difficult to conceive of CE-399 penetrating one person, striking no bone, and emerging virtually intact. But could CE-399 withstand the rest of the punishment the SBT requires of it?

As noted, the HSCA could not rely upon physical evidence to argue that CE-399 could do the job because they were unable to find such physical evidence. Therefore, in order to overcome this critical hurdle, the HSCA relied not upon science, experimentation, and physical re-creation, but upon yet another theoretical argument offered up to bear out the validity of the first theoretical argument.

Larry Sturdivan and the Diminishing Velocity Theory [5]

Larry Sturdivan presented what I term a Diminishing Velocity Theory during his 1978 HSCA testimony. As noted, it was his testimony upon which the HSCA concluded that CE-399 could indeed have inflicted the damage without suffering more distortion.[6] Curiously, even though Sturdivan's opinions are essential to the HSCA's SBT conclusion, Sturdivan never submitted a report of any kind. Sturdivan simply testified and acted as a behind-the-scenes consultant to the HSCA.

The Diminishing Velocity Theory goes like this; CE-399, being harder than the bone it encountered, could have caused all the Kennedy/Connally damage and remained intact *if* it struck the bones while traveling below the velocity at which it will deform, yet above that necessary to break the bones. Put another way, if CE-399 will deformed upon impacting an object if traveling at 'x' f/s or above and is traveling slower than that, and if the object being struck will deform at less than that impact velocity, the object struck (in this case bones) will be damaged and CE-399 will not. If, on the other hand, CE-399 struck bone *above* its own deformation impact velocity, both the bullet and the bone would suffer damage. The degree of deformation incurred by CE-399 is dependant to varying degrees upon three variables: a) the density of the bone struck (bone densities vary), b) the velocity at which the bullet impacts the bone, and c) the orientation of the bullet at the moment it strikes the bone.

In order to square CE-399's slight damage to the wounds suffered by Kennedy and Connally, its impact velocity must have been sufficiently diminished such that it fell below that velocity at which the round would greatly deform. It is this Diminishing Velocity Theory that is supposed to have proven out CE-399's ability to inflict great damage while suffering only minor damage itself.

As a practical matter, CE 399's alleged journey can be broken down into four stages:

1. Impact velocity on Kennedy's back/neck—through the neck—exit velocity
2. Impact velocity on Connally's back—through the chest—damage to 5th rib—exit velocity
3. Impact velocity on Connally's wrist—through the radius bone—exit velocity
4. Impact velocity on Connally's left thigh

Central to the Diminishing Velocity Theory is CE-399's "breakability," for lack of a better term. According to Sturdivan's 1978 HSCA testimony, that round will deform at 1,400 f/s or greater if it impacts bone in a nose-on attitude, i.e., strikes the bone directly.[7] Also according to Sturdivan, if the bullet was tumbling or yawing such that it struck the bone with its side, the impact velocity required to disrupt the round would be reduced to 1,000 f/s.[8] Given that the damage to CE-399 consists of a slight longitudinal twist and compression at its base, that bullet encountered something along its flight path. Whether the intervening objects were Kennedy and Connally as opposed a barrel of water, or a bale of cotton, is the question.

The Diminishing Velocity Theory reasonably, and with scientific credence, argues that a round will continue to lose velocity and shed kinetic energy with each new medium encountered.

We can think of kinetic energy as a credit card-type gift card loaded with $10. If you buy a $6 watch, you have $4 left. If you buy a $3 bag of potato chips, you have $1 left. If you buy a $1 pack of gum at the checkout, your card has no money left on it. Kinetic energy possessed by a bullet works the same way.

It is through the mis-implementation of these diminishing velocities that Larry Sturdivan led the HSCA astray, allowing it to improperly conclude that CE-399 could have caused the Kennedy/Connally damage.

Muzzle Velocity and the Impacts [9]

Once fired, the round will lose a certain amount of velocity on the way to the target as it pushes through air and the effects of gravity tug it earthward. The round will then lose a certain amount of velocity as it plows through the various tissues and bones. If the loss of velocity at each encounter is known with a fair degree of certainty, those numbers can be subtracted from the muzzle velocity. In this manner, the striking velocities can be reasonably calculated for each impact.

According to Sturdivan, a bullet fired from the CE-139 rifle will leave the barrel at between 2,000-2,200 f/s (its muzzle velocity). [10] Sturdivan gave no indication from where those numbers derive, although one assumes they came from the work performed at the Edgewood Arsenal where tests were conducted in 1964 for the WC. Those tests revealed an average muzzle velocity of 2,165 f/s.[11] (The temperature was colder on the east coast during the Edgewood Arsenal testing than it was in Dallas on the day of the assassination. Therefore, a bullet fired from the same rifle on 11/22 would have had a slightly higher muzzle velocity than indicated by the Edgewood tests.)

During his HSCA testimony, Sturdivan consistently used the 2,000 f/s number as the starting point for his Diminishing Velocity Theory. Throughout the remainder of this essay (with one exception noted in the text) we will use the lowest velocity numbers given, even if they are unfounded or contradicted by the evidence. In this manner, any errors or variances will work in favor of the official version, thus giving CE-399 the best odds of survival.

Stage 1, part 1: Impact on Kennedy's Back

Larry Sturdivan explained to the HSCA how much velocity would be lost as the bullet traveled from the muzzle to Kennedy's back:

> Mr. STURDIVAN. Well, the muzzle velocity of this bullet varies between 2,000 and 2,200 feet per second. It will have lost some velocity in traversing some distance. Say at 100 yards it would have about 1,800-feet-per-second velocity. [1HSCA407]

Note that Sturdivan stated loss of velocity from muzzle to impact at a minimum of 200 f/s (2,000 minus 1,800 for 200 f/s) over "*100 yards*", or 300 feet. A longer bullet-to-impact distance is advantageous to the official version for the reason that the longer the time of flight, the more velocity is shed. This, in turn, lessens the likelihood the round will deform. But a discrepancy arises, for the linear distance from the "Oswald" window to Kennedy at the moment of impact could not have been nearly "300 feet." The linear muzzle-to-impact distance at the HSCA designated impact (Zapruder frame 190 [Z-190]) is a mere 140 feet.[12] By comparison, the muzzle-to-impact distance at the moment President Kennedy emerged from behind the Stemmons Freeway sign (Z-225) was 175 feet, the head shot (Z-312/313) 255 feet.

Sturdivan overstated the distance between muzzle and target SBT shot. The effect, assuming Sturdivan calculated using "300 feet", is the unwarranted appearance that more velocity has been lost than would be the case. This mistake works in favor of the official version, which needs to shed every foot-per-second of velocity possible.

In order to resolve the discrepancy I sent an e-mail message to Sturdivan, citing his HSCA testimony and asking him for any clarification he could offer. Sturdivan was asked, "what would the impact velocity be for 140 and 175 feet assuming a 2,000 f/s muzzle velocity?" Sturdivan replied in a timely fashion with the following chart:

Range	Velocity		
0 ft	2000	2100	2200
140 ft	1917	2014	2112
175 ft	1896	1987	2083

From Sturdivan's chart, the lowest possible impact velocity on Kennedy's back would be 1,896 f/s at 175 feet (approximately Z-224). This comports with testimony given before the WC which indicated an impact velocity of 1,904 f/s at a range of 180 feet.[13] It does not, however, comport with the HSCA finding that Kennedy was hit at Z-190. Once again, in order to present the case most favorable to the official version we will use the highest velocity loss, and say that the bullet struck Kennedy's back traveling at 1,896 f/s.

It should be recognized at this point that the velocity numbers stated are not absolute, as small variables are involved. However, in order not to clutter the narrative, it should be assumed that the qualifier "approximately" precedes any velocity calculation.

Stage 1, part 2: Through Kennedy's Throat and the Exit Velocity

Sturdivan testified that, "this bullet if only encountering a few inches of soft tissue [in traversing Kennedy's neck] would go through losing almost no velocity, 100 feet per second or thereabouts."[14] In this instance, it would seem that Sturdivan erred against the official version, for there is evidence on the record of a greater loss of velocity through JFK's neck. That evidence comes from another wound ballistics expert who worked at the Edgewood Arsenal laboratory, Dr. Alfred Olivier.

Olivier conducted tests for the Warren Commission in 1964 where a round was fired from the CE-139 rifle through 14 centimeters of various types of tissue simulant: [15]

> Mr. SPECTER. What measurement was obtained as to the entrance velocity of the bullet at the distance of 60 yards which you described?
>
> Dr. OLIVIER. The striking velocity at an average of three shots was 1,904 feet per second.
>
> Mr. SPECTER. And what was the average exit velocity on each of the substances used?
>
> Dr. OLIVIER. For the gelatin the average exit velocity was 1,779 feet per second. The horsemeat, the average exit velocity was 1,798 feet per second. And the goatmeat the average exit velocity was 1,772 feet per second. [5H77]

Using the largest loss of velocity as stated by Olivier, an impact of 1,904 f/s and an exit of 1,772 f/s exit reveals a loss of 132 f/s as the bullet traveled through Kennedy's neck. This is greater than the 100 f/s quoted by Sturdivan. Therefore, if the bullet entered Kennedy's back at 1,896 f/s and lost 132 f/s, the exit velocity would be 1,764 f/s.

Stage 2, part 1: Impact Velocity on Connally's Back

Sturdivan testified that the hypothetical bullet "after going through [Kennedy]...is perhaps [traveling at] 1,700 feet per second, or a little less, at striking the second body." [16] Given that the bullet would have traveled a mere 60 centimeters between Kennedy's throat and Connally's back, it would have lost virtually no velocity.[17] Therefore, the impact on Connally's back would be on the order of 1,764 f/s. Yet Sturdivan quoted a slightly smaller number for the HSCA. Again, we will give the official version the benefit of the doubt and shave off 64 f/s of velocity per Sturdivan's testimony to arrive at an impact of 1,700 f/s at Connally's back.

Stage 2, part 2: Velocity Lost in Connally's Chest

A bullet entered Connally's back just to the left of his right armpit (as viewed from behind). That bullet tore through muscle and tissue and pulverized 4 inches (10 centimeters) of the right fifth rib as it coursed through the chest. It then exited 2 inches below, and slightly to the left (towards the body's midline) of the right nipple, tearing a 2 inch (5 cm) hole as it emerged.

Larry Sturdivan testified concerning the amount of velocity he expected would be lost as the missile traversed Connally's chest:

> Mr. STURDIVAN. So it is after going through [Kennedy's neck] it is perhaps 1,700 feet per second, or a little less, at striking the second body. There it would lose another 400-plus feet per second and exited, say, somewhere between 1,100 and 1,300 feet per second, roughly.
>
> Mr. FAUNTROY. That is velocity at which it is moving?
>
> Mr. STURDIVAN. At the exit of the second target. [1HSCA409]

Sturdivan's statement that the bullet lost around 400 f/s velocity in traversing Connally's chest agrees with the Warren Commission testimony of Arthur Dziemian, a wound ballistics expert at the Edgewood Arsenal. Dziemian told the Warren Commission in 1964 that tests revealed the bullet would lose +400 f/s on its way through Connally's chest.[18] Sturdivan, however, added some wiggle room during his testimony when he stated that the bullet would enter at 1,700 f/s, loose 400 f/s to exit at "between 1,100 and 1,300" f/s. Obviously, that math is incorrect; 1,700 minus 400 is 1,300, not 1,100. Therefore, we will use 1,300 f/s. In doing so, a critical problem for the official version arises, for the bullet was going too fast, and thus carrying too much kinetic energy. Consider this: If the bullet entered Connally's back at 1,700 f/s and lost 400 f/s in the chest, that means that the bullet struck the rib at no less than 1,300 f/s. The reader will recall that Sturdivan testified that if the bullet "strikes bone" "sideways, which is a weaker orientation, it will deform at 1,000 feet per second."[19] And yet we find that the 1,300 f/s CE-399 is only slightly flattened.

[editor's note: In her 1997 essay The Magic Fragments and Other Stories, Milicent Cranor pointed out that the problem that a supposed sideways Connally back hit, at an impact speed approximating that of the "wrist strike" tests, should have caused CE 399 to deform further, due to the fact that Connally's wrist and ribs were of comparable density.]

The Real Numbers

When we add back to the theory the numbers derived from the actual testing, we get an even higher "rib strike" velocity. We start with a muzzle velocity of 2,165 f/s, we subtract 100 f/s from the muzzle to Kennedy's back, we subtract another 132 f/s as the bullet passed through the neck and we are left with an impact on Connally's back of 1,933 f/s, not the significantly tamer 1,300 f/s. If we subtract 400 f/s for the velocity lost in Connally's chest, we have an exit velocity of approximately 1,533 f/s! The side of CE-399, which deforms above 1,000 f/s, is marginally flattened, yet the bullet must have struck the rib at no less than 1,500 feet per second. In fact, the impact velocity on striking the rib would have been greater, for if it exited at 1,500 f/s, that would have been *after* the bullet lost significant velocity in smashing the rib. Therefore, the bullet would have been traveling faster than 1,500 f/s when it hit the rib. Even using the official test-derived velocity numbers, CE-399 is not nearly as deformed as it must have been had it hit John Connally's rib traveling at more than 1,500 f/s.

A Way Out of the Box?

The only saving grace for the SBT is the possibility that CE-399 was tumbling or greatly yawed as it entered Connally's and tore through his chest. In that scenario, the bullet would have presented a larger surface area and thus shed significantly more kinetic energy before it hit the rib than if it had simply drilled through "nose on."

The evidence for a tumbling/yawing bullet comes from exactly one source; Thoracic Surgeon, Robert Shaw's post-operative report on Connally's chest surgery. There, Shaw described the size of the entry wound in Connally's back as 3 cm, which would be quite elongated considering that the bullet is 6.55 mm in diameter. Some authors have reasonably taken the 3 cm entry hole to mean that the bullet was yawing heavily or tumbling when it hit Connally.

The problem with the tumbling/yawing scenario is that the totality of the evidence tells us that the entry wound was not 3 cm. Firstly, we have HSCA Forensic Pathology Panel member Charles Petty's report detailing his 11/9/77 interview of Shaw:

> **The wound in the back was shaped as if the bullet had entered at a slight declination** [according to Shaw]. Shaw probed through this wound with his finger and felt the Penrose drain that he had placed in the latissimus dorsi muscle.
>
> **In measuring the diagram made by Doctor Shaw at the time of this interview so the better to illustrate the size of the entrance and exit wounds, it is interesting that the entrance wound measurement taken from this diagram are 1.5 x 0.8 cm.** with the long dimension in the longitudinal plane of the body (the long axis of the body) and that the exit wound is approximately 5 cm. in greatest dimension.
>
> At the conclusion of the interview Doctor Shaw signed the diagram this was witnessed by Purdy, Flanigan [sic], and Petty, the original copy taken by Purdy. [7HSCA324] (Emphasis added)

Shaw told Petty the wound was not 3 cm, then diagramed it to scale at 1.5 cm. I searched for and found the original drawing marked by Shaw for the HSCA. (See Figure 1.)

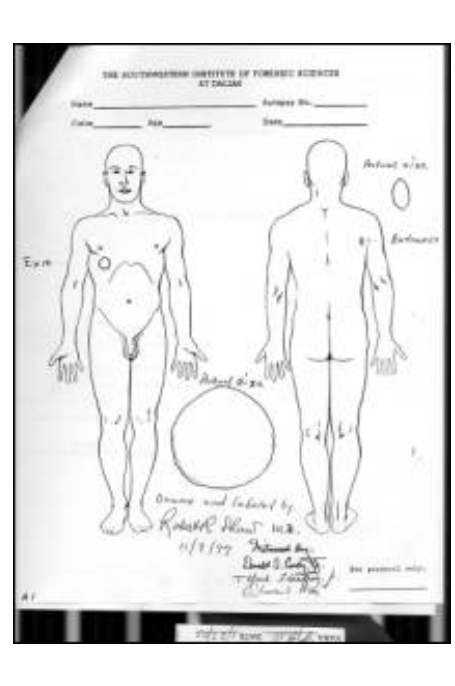


Figure 1
The author's computer scan of the original document
marked by Shaw for the HSCA
(click to enlarge)

Petty was correct; Shaw's scale drawing of the entry hole was "1.5 x 0.8 cm." That Shaw was of the opinion that the entry hole in Connally's back was not 3 cm is also backed up by his Warren Commission testimony where he described the wound was "approximately a centimeter and a half in length."[20] Fourteen years later, Shaw told HSCA staffer, Andrew Purdy the same thing. This is how Purdy characterized Shaw's recollection:

> The rear entrance wound was not 3 cm as indicated in one of the operative notes. It was a puncture-type wound, as if a bullet had struck the body at a slight declination (i.e. not at a right angle). The wound was actually approximately 1.5 cm. The ragged edges of the wound were surgically cut away, effectively enlarging it to approximately 3 cm. [7HSCA325] (Emphasis is original.)

Notice that in both the Petty and Purdy interviews, Shaw is reported to have been of the opinion that the Connally's wound was created by a bullet that hit the skin on an angle and was not 3 cm in width as originally reported. The size of the entry hole as derived from Shaw's diagram (1.5 x 0.8 cm) is backed up by the size of the holes in the shirt and coat Connally wore that day.

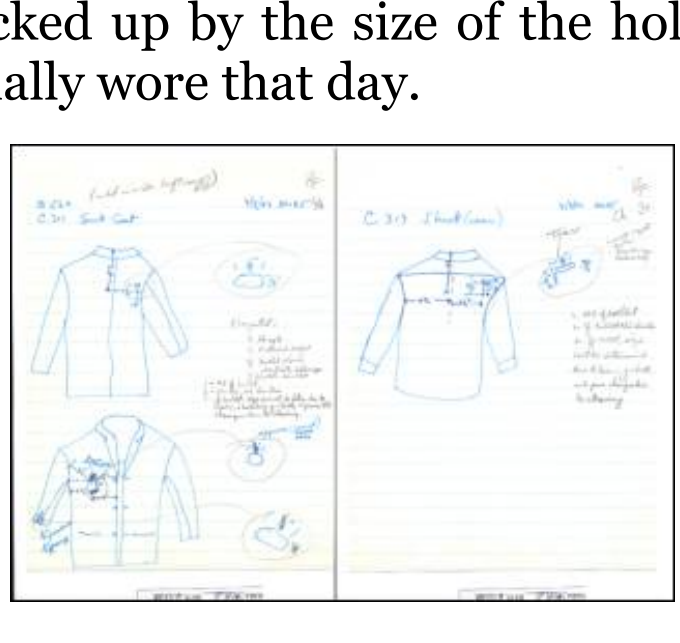


Figure 2. The author's computer scan of Robert Frazier's original diagrams of the bullet holes on the back of Connally's shirt and jacket.
(Click to enlarge)

According to FBI Laboratory Lead Examiner on the JFK case, Robert A. Frazier, the holes in the shirt and jacket were 5/8 of an inch (1.7 cm) in maximum diameter. There is no question that the clothing could have been oriented any number of ways which would effect the nature and size of the defects. However, the size of the holes are in keeping with Shaw's description of a 1.5 cm entry hole, and not in keeping with a 3 cm wound.

In the final analysis, there is no evidence that the bullet that hit Connally in the back was tumbling or yawing, although it may have been. Unfortunately, Shaw did not note the presence and nature of any abrasion collar which might have served to clarify the matter. Whether the bullet tumbled or yawed after entry and before it struck Connally's rib is open to discussion. The remarkably slight damage extending from the entry to the smashed rib as described in Shaw's operative report speaks more to a stable bullet than a tumbling/yawing bullet. Unfortunately, it is not possible to say anything more definitive than that.

Enter the Discovery Channel

A program aired on the Discovery Channel in 2004 recounting a re-creation of the SBT performed in Australia in October, 2004. The anatomic re-creation of Kennedy's neck and Connally's chest and wrist was far and away the most sophisticated, realistic ever performed in the JFK case. Using 6.5 mm WCC ammunition and a Mannlicher-Carcano like that found in the Depository, they duplicated the paths required by the SBT remarkably closely. The results of that test bear out of the notion that CE-399 could not have inflicted Connally's injuries. Below is a screen shot of the bullet that passed through "JFK" and went through "Connally's" rib and wrist. (See Figure 3.)

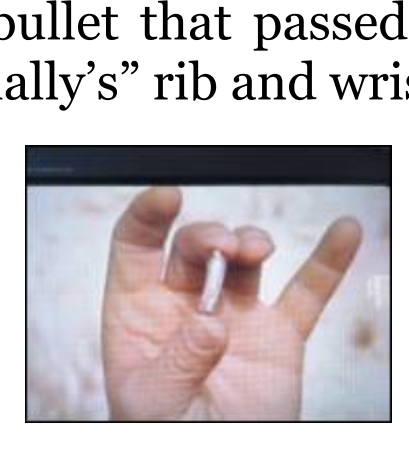


Figure 3.
(Click to enlarge)

The Discover Channel's "Single Bullet" went through *less* rib than the bullet that went through Connally and was grossly distorted in comparison to CE-399. (See Figure 4.)

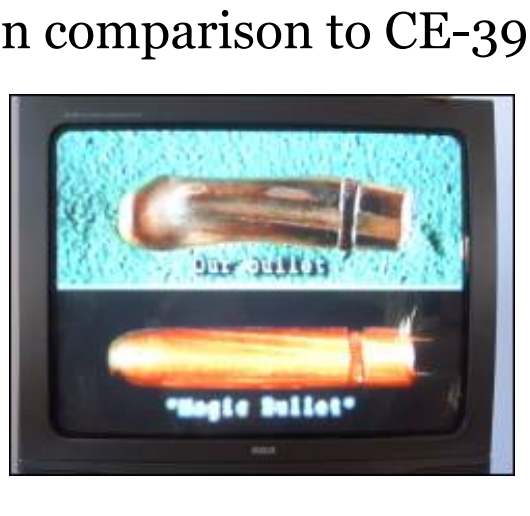


Figure 4.
(Click to enlarge)

Some might argue that because the Discovery Channel bullet went through two ribs whilst traveling sideways, the results of the test cannot tell us anything about the JFK assassination. (See Figure 5.)

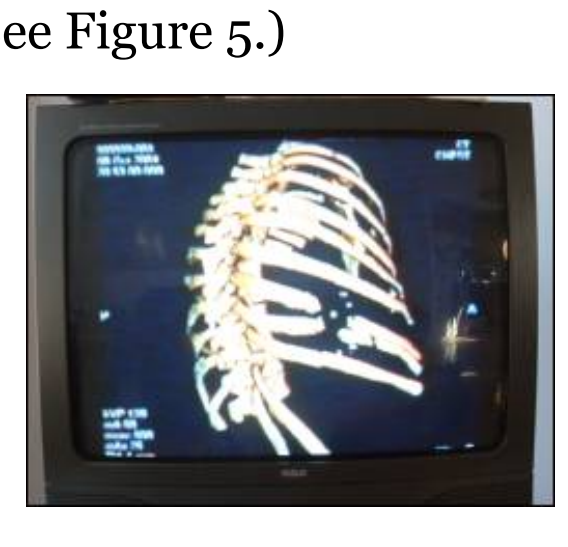


Figure 5.
(Click to enlarge)

This viewpoint would be wrong for a simple, logical reason: CE-399 hit whatever it hit with its side and so did the Discovery Channel bullet. And even though the Discovery Chanel bullet struck two ribs, it did not pulverize nearly 10 cm of bone, as was the case with the bullet that went through Connally's chest.

Despite the Australian marksman's claim that their tests validated the SBT, anyone with functioning eyes and at least two working brain cells can see that was not the case at all. Despite the on-camera proclamation, the Discovery Channel bullet produced less damage and incurred significantly more deformity than the SBT can tolerate.

The Discovery Channel's excellent re-creation puts the final nail in CE-399's coffin and proves out what the Diminishing Velocity Theory predicted; the bullet that hit John Connally in the chest would have deformed grossly. Whatever CE-399 went through, the evidence tells us it was not John Connally.

Postscript

Larry Sturdivan authored a book on the JFK case entitled, *The JFK Myths; a Scientific Investigation of the Kennedy Assassination*. Sturdivan had sent me an electronic copy of the near-penultimate draft, asking for my feedback and commentary. In the acknowledgment section of Sturdivan's book we find this wording:

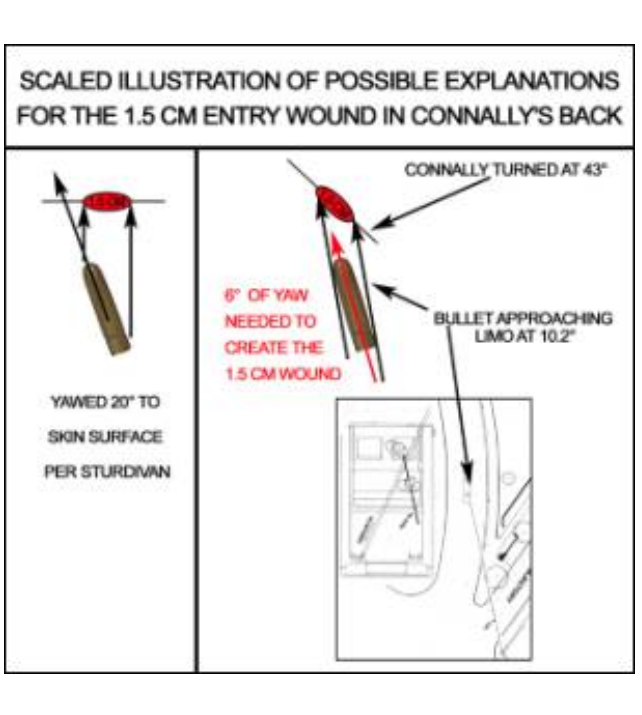
> Mr. John Hunt, Kennedy Assassination Investigator, for supplying hard to get material from the Archives and spotting distracting errors in the text.

I appreciate Larry's "thank you," but take exception with the notion that all I did was "spot distracting errors in the text." Although I did spot many errors of fact missed by others, I also offered detailed critiques and counter points to many of the foundations upon which Sturdivan based his conclusions. For instance, I informed him of Robert Shaw's 1978 correction of the record regarding the size of the entry wound in Connally's back and sent him a copy of the diagram Shaw marked for the HSCA. I also argued that Connally was in all likelihood turned to the right when the bullet struck and that that could well account for the elongated wound, which is exactly what Dr. Robert Shaw concluded. Sturdivan acknowledged in his book the fact that Shaw was of the opinion that the entry hole in Connally's back was actually only 1.5 cm long, not 3 cm as related in his report:

> A WCC/MC bullet striking at a large angle of yaw, however, will make a distinctly elongated hole in the target. In his hospital report, Dr. Shaw gave the length of the entry wound as three centimeters (1.2 inches), but in his testimony [sic] to the House FPP he said that it was actually 1.5 cm. **In either case the horizontal hole in Connally's back was so long that it could only have been made by a bullet at large yaw; far too large for any Mannlicher-Carcano bullet in normal flight**. The yawed entry is shown in Figure 28. [65] [Sturdivan, pg. 138.] (Emphasis added)
>
> [Footnote #65: This figure is reproduced from the HSCA drawing. It shows an exaggerated "tumbling" motion before strike that is somewhat misleading. T**he yaw grew from a few degrees when it left Kennedy's neck to a bit more than 20° (the 1.5 cm hole)** when it struck Connally's back. The yaw, like the hole, was nearly horizontal, not vertical like that in the figure.] [Sturdivan, pg. 138.] (Emphasis added)

Here, Sturdivan tells us that the 1.5 cm entry hole means the bullet ***must*** have been yawing significantly when it hit Connally. Yet at no point does Sturdivan explain *why* the size of the hole indicates the bullet *must* have entered Connally "at a large yaw." The closest Sturdivan comes is in the footnote noted above – "The yaw grew from a few degrees when it left Kennedy's neck to a bit more than 20° (the 1.5 cm hole) when it struck Connally's back."

Sturdivan apparently based his guess at the amount of yaw by comparing of the length of the bullet to the width of the wound. That is to say, CE-399 must be yawed at 20° in order for the 6.55 mm round to create the 1.5 cm elongated hole. Sturdivan left out one important factor (even though I advised him of it in my critique of his manuscript); Sturdivan did not take into account is the fact that Connally was likely turned to his right when struck. This has enormous possible consequences for any estimate of yaw based upon the size of the entry hole. Figure 6 illustrates the situation to scale.



SCALED ILLUSTRATION OF POSSIBLE EXPLANATIONS FOR THE 1.5 CM ENTRY WOUND IN CONNALLY'S BACK
CONNALLY TURNED AT 43°
6° OF YAW NEEDED TO CREATE THE 1.5 CM WOUND
BULLET APPROACHING LIMO AT 10.2°
YAWED 20° TO SKIN SURFACE PER STURDIVAN

Figure 6.
The angle of approach from the TSBD to the limo would change slightly depending on how far or near one places the SBT impact. (The HSCA-derived Zapruder frame 190 impact was used for the illustration. It does not represent the author's opinion.) The overall difference in the angle of approach would be slight and cannot rehabilitate Sturdivan's claim.
(Click to enlarge)

If Connally were turned approximately 43° to the centerline of the limo and the bullet was approaching the limo at 10.2° right to left, a mere 6° of yaw is required to create the 1.5 cm wound. The bottom line is that Sturdivan did not and cannot make a case for a "large yaw" on entry based upon the evidence. The very strongest statement that can rightfully be made is that the bullet might have been yawing or tumbling, and it might not have been.

Sturdivan's "20°-yaw-because-of-the1.5-cm-entry-hole" conclusion fails for a second time as well. Consider this: the hole in JFK's skull was reported to be 1.5 cm in length. Therefore, under Sturdivan's rule of thumb, the bullet that hit JFK in the head must have been tumbling as well. Yet there was no intervening object between the Depository window and JFK's head at the moment it exploded. What, one wonders, caused the headshot bullet to tumble?

Sturdivan concluded in his book that CE-399 went through Connally. It is the supposed yawing or tumbling that allows Sturdivan to shave precious kinetic energy from his Diminishing Velocity Theory, such that CE-399 could be the instrument of damage. If the bullet were tumbling or greatly yawed, it would certainly have shed more kinetic energy prior to striking Connally's rib, and thus impacted the rib at a lower velocity. That lower velocity is critical to CE-399's ability to be mildly deformed and still have wounded Connally. Once Sturdivan weakly concludes that the bullet was, without question, yawing on impact, he never looks back. Having taken for granted that the bullet was yawing/tumbling Sturdivan draws critical inferences that allow CE-399 to be the culprit. But simply claiming that the bullet was yawing/tumbling without any evidence for that doesn't make it so. The fact of the matter is that Sturdivan's selective use of the evidence moves us no closer to a genuine understanding what happened on November 22, 1963.

The Draft

Virtually all of what you have just read (with the exception of this postscript and the Discovery Channel material) was completed three years before I saw Larry's manuscript. I was at that point well aware of his HSCA testimony. On page 82 of that draft Sturdivan produced a chart (Table II) explaining the diminishing velocities. I immediately noticed a discrepancy; the nose on impact deformation velocity was listed as 1700 f/s and side impact as 1440 f/s. Yet Sturdivan told the HSCA in 1978 that the nose on deformation velocity was "1,400 f/s" and the side impact deformation velocity was a mere "1000 f/s." In my lengthy response to his draft, I made Sturdivan aware of the discrepancy:

> Table II: Approximate Velocities At Which Mannlicher-Carcano Bullets and Bones Will Be Deformed **[HUNT: The bone impact deformation numbers below (Table II) differ substantially from your HSCA testimony of 1000 f/s:**
>
>> Mr. STURDIVAN. OK, the bullet would begin to deform, if it strikes say, soft tissue, at something--remember, the density of soft tissue is around one, the density of water, and it will begin to deform at something in excess of 2,000 feet per second. In other words, at the muzzle velocity of the Mannlicher-Carcano.
>>
>> If it strikes bone, which is twice as dense, then it would begin to deform nose on at approximately 1,400 feet per second. **If the bullet turns sideways, which is a weaker orientation, it will deform down to around 1,000 feet per second**. 1HSCA396
>
> **Those of us who are familiar with your HSCA testimony would look for some explanation as to why your impact deformation numbers changed between 1978 and 2005.]**

That very same chart appears on page 118 of Sturdivan's book. Sturdivan also quotes 1,450 f/s as the side impact deformation velocity on page 144. Having made Sturdivan aware that at least one person (me) was aware his new, more SBT–friendly impact deformation velocity numbers, I expected him to advise the reader that the numbers had changed between his HSCA testimony and the publication of his book, which he did. I also expected Sturdivan to address the far more important question, "What precipitated the SBT-friendly change in velocities?". And what did Sturdivan write after having been made aware of my concerns? Nothing more than this footnote:

> 68. These [the velocity deformation numbers in Table II] differ from the estimates given to the HSCA in 1978, as they were redone for this book. The reader is cautioned that both sets are only rough approximations. [Sturdivan, pg. 143.]

Sturdivan merely told the reader that the numbers were "redone" for the book. And yet in a matter critical to his theory, the *reason* the numbers were "redone" is never spelled out, not even in *Appendix B, Retardation and Deformation of Bullets*. Did Sturdivan do new calculations? Apparently. If so, based upon what new information? Did he conduct new tests? None that we are informed of. To date, we don't know why Sturdivan changed the numbers. We do, however, know what the end result was. According to Sturdivan, between 1978 and 2005 CE-399 somehow became a stronger bullet. Perhaps like a fine wine, Western Cartridge Co. Mannlicher-Carcano bullets improve with age.

Tumble Schmumble

Sturdivan attached a lot of weight to the conclusion that a yawing bullet would shed enough kinetic energy such that it struck Connally's rib only slightly above its own sideways impact deformation velocity. Unfortunately for Sturdivan, even injecting the Magic Bullet with theoretical steroids can not rehabilitate the SBT, for the Discovery Channel "Single Bullet" *did* impact the "Connally" trunk while severely yawed and was still grossly deformed upon impact with the rib.

There was not a word about the Discovery Channel special in the draft I received, and so I made Sturdivan aware of the serious consequences that show had on what he'd written and was prepared to publish. Sturdivan added this to his manuscript:

> In the Discover Channel special,…**the bullet was a direct strike on the rib** and **was deformed to a greater extent than** Lattimer's bullet, CE 399, or **CE 853, the Biophysics Division [test bullet] that grazed the goat rib** in a manner similar to CE 399's grazing strike on Connally's rib. The discovery Channel's bullet resembles the bullets that made direct strikes on the [goat] ribs in the Biophysics test. [Sturdivan, pg.129] (emphasis added)

Here Sturdivan has made three errors, two of fact and one of logic.

Error #1 - Sturdivan attempts to blunt the importance of the Discovery Channel results by informing the reader that the bullet struck head on. The fact is that the Discovery Channel bullet struck "Connally" sideways, a fact that elated the Australians, who termed it a "keyhole" entry.

Error #2 – According to Sturdivan, "The discovery Channel's bullet resembles the bullets that made **direct strikes** on the [goat] ribs in the Biophysics test." The fact is that the bullet that most closely duplicated the Connally wounding in the Biophysics goat tests look just like the Discovery Channel–smashed. And that bullet struck the goat rib a glancing blow. Here, reproduced for the first time, is a side view of that bullet I discovered at the National Archives. (See Figure 7).

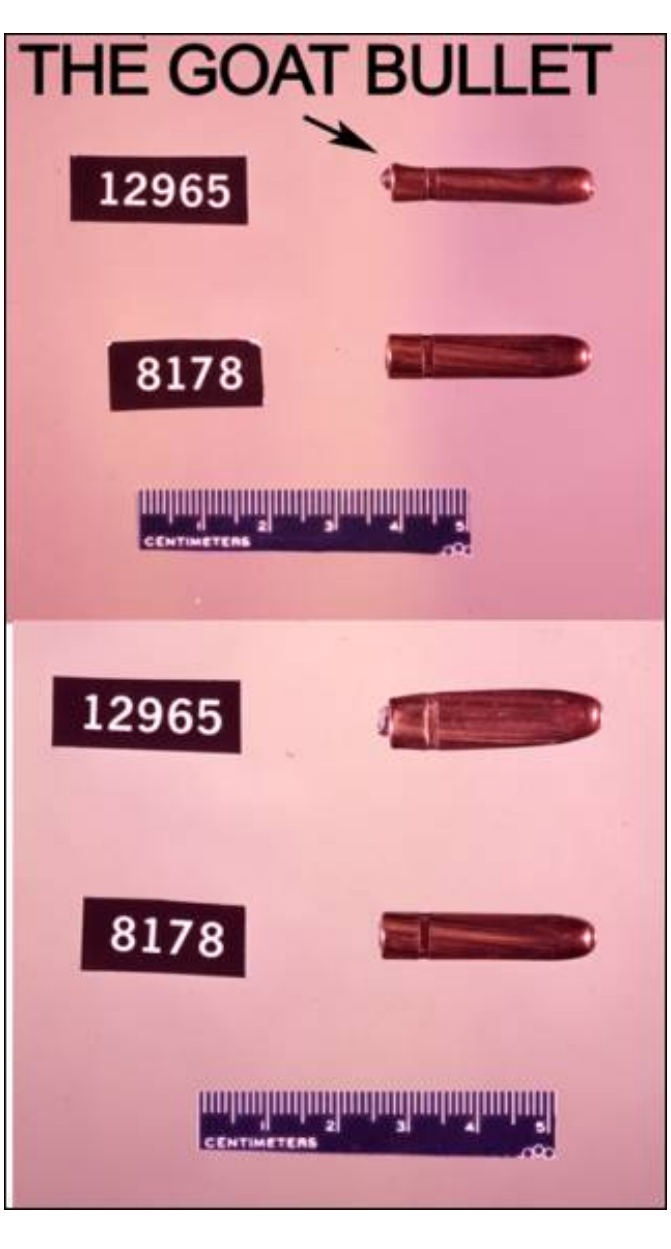


Figure 7 – Bullet (#12965) fired through a goat that most closely simulated Connally's chest wound (see arrow). The other bullet pictured (#8178) was apparently the result of a soft-recovery test firing. It is not CE-399. (The author's computer scan of the original 4 x 5 Biophysics color transparency. The image appears pink due to fading of the original color negative's blue tones over time. This is, unfortunately, a common phenomenon with the color negatives and transparencies at NARA. I petitioned NARA to save the images before they degrade further. To date, nothing has happened.)
(Click to enlarge)

As can be seen from the once-suppressed photographs of the "goat bullet," the nose is the only part of the bullet that is not grossly deformed. Olivier's own report (page 15) states that the bullet pictured in Figure 7struck a glancing blow on the goat rib.[21] Despite Sturdivan's claim that the bullet that struck the Discovery Channel rib matches the glancing-shot goat bullet, it did not.

Error 3 - The error in logic is evidenced by Sturdivan's claim that the bullet is stronger when striking nose-on, which it is. Had the Discovery Channel bullet struck nose on, it should have been *less damaged*, not *more* as Sturdivan insinuates.

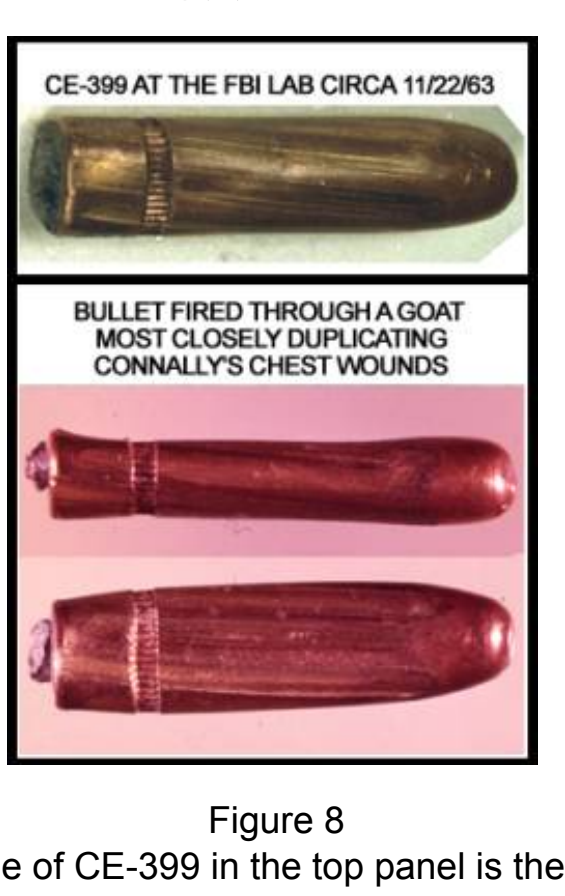
The bottom line is that the Discovery Channel tests prove out what the Diminishing Velocity Theory predicted; a 6.5 mm WCC/MC fired through JFK's neck would have significant remaining velocity on impact with Connally's back and rib. This velocity is simply too high to allow CE-399 to create Connally's wounds and emerge in the mildly deformed condition in which we find it.

And with CE-399 goes the Single Assassin theory of the JFK assassination.

Sturdivan concludes near the end of his book that:

> When one of these bullets [WCC/MC] struck Connally's rib, **the extent of its deformation is** totally in accord with physical theory, **and very similar to the deformation of an identical bullet which produced a similar wound in a goat's ribcage**. **Even the slight difference in the amount of deformation to these two bullets is accounted for by the difference in the amount of soft tissue penetrated**, and the resulting velocity lost, before striking rib. [Sturdivan, pg. 244] (emphasis added)

Sturdivan tells the reader that CE-399 and the bullet test fired through the goat suffered "very similar deformation," and characterizes the difference in deformity as "slight." As Figure 8 demonstrates, the goat bullet is significantly more deformed than CE-399.



CE-399 AT THE FBI LAB CIRCA 11/22/63
BULLET FIRED THROUGH A GOAT MOST CLOSELY DUPLICATING CONNALLY'S CHEST WOUNDS

Figure 8
The image of CE-399 in the top panel is the author's computer scan of an FBI color negative and is reproduced here for the first time.

(Click to enlarge)

As if to blunt that fact, Sturdivan continues on to say that "even the slight difference in the amount of deformation to these two bullets is accounted for by the difference in the amount of soft tissue penetrated, and the resulting velocity lost, before striking rib." According to Sturdivan, CE-399 is not as deformed as the goat bullet because it would have gone through more tissue in Connally than it did in the goat prior to striking the rib. Therefore, CE-399 could have caused Connally's wounds and remained in the shape in which we find it.

Again, we find Sturdivan falling back upon his unproven root assumption that the bullet was significantly yawed when it hit Connally and thus was able to shed enough velocity before striking the rib. As noted, simply claiming that was the case does not make it so.

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[1] The HSCA Report concludes on page 47 (HSCAR47), that "Taken together with other evidence, the photographic and acoustical evidence led the committee to conclude that President Kennedy and Governor Connally were struck by one bullet at approximately Zapruder frame 190, and that the President was struck by another bullet at frame 312."

[2] Dr. Vincent Guinn performed Neutron Activation Analysis (NAA) tests for the HSCA. Guinn testified that, "CE-399 and 842 (the Connally wrist fragments), agree so closely in their antimony concentration and their silver concentrations that I could not distinguish one from the other (1HSCA554)." Yet Guinn's own tests proved that **two separate and unrelated test bullets matched better than CE 399 and the Connally wrist fragments**.(6002A and 6003A2 at 1HSCA547-550)

[3] The references are as follows:

(37) Sturdivan testimony, pp. 407-412, 420-424; see also testimony of Dr. Cyril H. Wecht, Sept. 7, 1978, I HSCA-JFK hearings, 350-352 (hereinafter Wecht testimony).
(38) Id., Sturdivan testimony, at 395.
(39) Id., Sturdivan testimony, 407-412, 420-424, and Baden testimony, 298.

[4] 3H400.

[5] The term "Diminishing Velocity Theory" is mine and was not used by Sturdivan.

[6] HSCAR45.

[7] 1HSCA396.

[8] 1HSCA396.

[9] For the proposes of this analysis alone, it will be presumed that a SBT bullet was fired by the CE-399 rifle from the southeast corner window on the sixth floor window of the TSBD.

[10] 1HSCA497.

[11] 3H400.

[12] The distances cited throughout this essay were measured directly from a full-scale copy of the 1/20 scale topographic survey map generated for the HSCA by Drommer and Assts., as revised in March of 1981. The accuracy for a given distance is plus/minus 12 inches. The author recognizes that the distances stated are not absolute because the finite accuracy of the HSCA map is not know with certainty. However, in order not to clutter the narrative, it should be assumed that the qualifier "approximately" precedes any Dealey Plaza distance stated.

[13] 5H77.

[14] 1HSCA407

[15] 14 cm is the commonly accepted distance a bullet would have traveled through Kennedy's neck.

[16] 1HSCA409.

[17] 2HSCA185, 6HSCA54

[18] 5H86

[19] 1HSCA396

[20] 6H86

[21] HSCA 180-10096-10237(see excerpt from pg. 15)